the portion of the part of the formation comprises a total organic matter weight percentage of at least about 5.0 %; and

producing a mixture from the formation.

Sub E1

1728. (amended) The method of claim 1727, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

1729. (amended) The method of claim 1727, further comprising maintaining a temperature within the part of the formation within a pyrolysis temperature range from about 270 °C to about 400 °C.

1730. (amended) The method of claim 1727, wherein the one or more heaters comprise electrical heaters.

C3

1731. (amended) The method of claim 1727, wherein the one or more heaters comprise surface burners.

1732. (amended) The method of claim 1727, wherein the one or more heaters comprise flameless distributed combustors.

1733. (amended) The method of claim 1727, wherein the one or more heaters comprise natural distributed combustors.

1734. (amended) The method of claim 1727, further comprising controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

1735. (amended) The method of claim 1727, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day during

pyrolysis within a pyrolysis temperature range of about 270 °C to about 400 °C.

1736. (amended) The method of claim 1727, wherein providing heat from the one or more heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from the one or more heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

1738. (amended) The method of claim 1727, wherein providing heat from the one or more heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C).

1750. (amended) The method of claim 1727, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

1753. (amended) The method of claim 1727, further comprising controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bars absolute.

1758. (amended) The method of claim 1727, further comprising:

providing hydrogen (H_2) to the part of the formation to hydrogenate hydrocarbons within the part of the formation; and

heating a portion of the part of the formation with heat from hydrogenation.

Sub E4

1760. (amended) The method of claim 1727, wherein allowing the heat to transfer comprises increasing a permeability of a majority of the part of the formation to greater than about 100 millidarcy.

C8

1761. (amended) The method of claim 1727, wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation.

Sub F1

1763. (amended) The method of claim 1727, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

1764. (amended) The method of claim 1727, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.

C9

1765. (amended) The method of claim 1727, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

1766. (amended) A method of treating a hydrocarbon containing formation in situ, comprising:

providing heat from one or more heaters to at least a portion of the formation;

allowing the heat to transfer from the one or more heaters to a part of the formation;

wherein at least some hydrocarbons within the part of the formation have an initial total organic matter weight percentage of at least about 5.0%; and

producing a mixture from the formation.

1767. (amended) The method of claim 1766, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

1768. (amended) The method of claim 1766, further comprising maintaining a temperature within the part of the formation within a pyrolysis temperature range from about 270 °C to about 400 °C.

1769. (amended) The method of claim 1766, wherein the one or more heaters comprise electrical heaters.

1770. (amended) The method of claim 1766, wherein the one or more heaters comprise surface burners.

1771. (amended) The method of claim 1766, wherein the one or more heaters comprise flameless distributed combustors.

1772. (amended) The method of claim 1766, wherein the one or more heaters comprise natural distributed combustors.

1773. (amended) The method of claim 1766, further comprising controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

1774. (amended) The method of claim 1766, further comprising controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day during pyrolysis within a pyrolysis temperature range of about 270 °C to about 400 °C.

1775. (amended) The method of claim 1766, wherein providing heat from the one or more heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from the one or more heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

1777. (amended) The method of claim 1766, wherein providing heat from the one or more heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C).

1789. (amended) The method of claim 1766, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

1792. (amended) The method of claim 1766, further comprising controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bars absolute.

1797. (amended) The method of claim 1766, further comprising:

providing hydrogen (H_2) to the part of the formation to hydrogenate hydrocarbons within the part of the formation; and

heating a portion of the part of the formation with heat from hydrogenation.

1799. (amended) The method of claim 1766, wherein allowing the heat to transfer comprises increasing a permeability of a majority of the part of the formation to greater than about 100 millidarcy.

Sub E13 C14

1800. (amended) The method of claim 1766, wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation.

Sub F1

1802. (amended) The method of claim 1766, wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

C15

1803. (amended) The method of claim 1766, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern.

1804. (amended) The method of claim 1766, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

Sub F1

C16

5396. (amended) The method of claim 1763, wherein at least about 20 heaters are disposed in the formation for each production well.

5397. (amended) The method of claim 1802, wherein at least about 20 heaters are disposed in the formation for each production well.

Response To Office Action Mailed June 13, 2002

A. Pending Claims

Claims 1727-1804, 5396, and 5397 are pending. Claims 1727-1736, 1738, 1750, 1753, 1758, 1760, 1761, 1763-1775, 1777, 1789, 1792, 1797, 1799, 1800, 1802-1804, 5396, and 5397 have been amended.

B. Submission of Corrected Formal Drawings

In the Office Action mailed June 13, 2002, the Examiner indicated approval of the proposed drawing corrections filed on February 28, 2002 [mailed on February 14, 2002]. Applicant submits the corrected formal drawings approved by the Examiner (nine sheets, including FIGS. 23a, 23b, 32, 56, 57, 67, 68, 72, 73, 76, 81a, and 97).

C. Provisional Double Patenting Rejection

The Examiner provisionally rejected claims 1727-1804, 5396, and 5397 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims of copending U.S. Patent Application Nos.:

09/840,936; 09/840,937; 09/841,000; 09/841,060, 09/841,061; 09/841,127; 09/841,128; 09/841,129; 09/841,130; 09/841,131; 09/841,170; 09/841,193; 09/841,194; 09/841,195; 09/841,238; 09/841,239; 09/841,240; 09/841,283; 09/841,284; 09/841,285; 09/841,286; 09/841,288; 09/841,289; 09/841,290; 09/841,291; 09/841,292; 09/841,293; 09/841,294; 09/841,295; 09/841,296; 09/841,297; 09/841,298; 09/841,299; 09/841,300; 09/841,301; 09/841,302; 09/841,303; 09/841,304; 09/841,305; 09/841,306; 09/841,307; 09/841,308; 09/841,309; 09/841,310; 09/841,311; 09/841,312; 09/841,429; 09/841,430; 09/841,431; 09/841,432; 09/841,433; 09/841,434; 09/841,435; 09/841,436; 09/841,437; 09/841,438; 09/841,439; 09/841,440; 09/841,441; 09/841,442; 09/841,443; 09/841,444; 09/841,445; 09/841,446; 09/841,447; 09/841,448; 09/841,449, 09/841,488; 09/841,489; 09/841,490; 09/841,491; 09/841,492; 09/841,493; 09/841,494; 09/841,495; 09/841,496; 09/841,497; 09/841,498; 09/841,499; 09/841,500; 09/841,501; 09/841,502; 09/841,632; 09/841,633; 09/841,634; 09/841,635; 09/841,636; 09/841,637; 09/841,638; and 09/841,639.

Applicant respectfully traverses the provisional double patenting rejection. Applicant respectfully submits that the omnibus nature of this rejection does not provide Applicant with sufficient detail in which to address such rejection. Applicant also respectfully submits that the rejection is also inconsistent with certain restrictions issued in the above-referenced cases. Applicant respectfully requests reconsideration.

Pursuant to the discussion in an Examiner interview on August 19, 2002, for the convenience of the Examiner, Applicant will forward copies of allowed claims for the above-referenced cases to the Examiner. Applicant understands that the Examiner will review the allowed claims for the above-referenced cases and then reconsider the double patenting rejection in view of such allowed claims.

D. The Claims Are Definite Pursuant To 35 U.S.C. § 112, Second Paragraph

Claims 1727-1804, 5396, and 5397 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicant respectfully disagrees with these rejections.

The Examiner rejected claims 1763 and 1802 as being "unclear regarding 'at least about 7 heat sources'. The modified 'about' is not normally used in reference to an integer count (i.e., a number of sources); thus it is unclear what the scope of the claim is." (Office Action, page 5)

The fact that claim language, including terms of degree, may not be precise, does not automatically render the claim indefinite under 35 U.S.C. 112, second paragraph. Seattle Box Co., v. Industrial Crating & Packing, Inc., 731 F.2d 818, 221 U.S.P.Q. 568 (Fed. Cir. 1984).

Applicant submits that the number of heaters per well is an average number of heaters per production well in a unit cell of the formation. Support for this interpretation is found at least in the paragraphs of the Specification cited below.

> The total number of heat sources 400 in unit cell 404 may include six full heat sources 400a that are each counted as one heat source, and six partial heat sources 400b that are each counted as one half of a heat source. Therefore, a ratio of heat sources 400 to production wells 402 in unit cell 404 may be determined as 9:1. A ratio of heat sources to production wells may vary, however, depending on, for example, the desired heating rate of the hydrocarbon containing formation, the heating rate of the heat sources, the type of heat source, the type of hydrocarbon containing formation, the composition of hydrocarbon containing

formation, the desired composition of the produced fluid, and/or the desired production rate. Providing more heat sources wells per unit area will allow faster heating of the selected portion and thus hastening the onset of production, however more heat sources will generally cost more money to install. An appropriate ratio of heat sources to production wells may also include ratios greater than about 5:1, and ratios greater than about 7:1. In some embodiments an appropriate ratio of heat sources to production wells may be about 10:1, 20:1, 50:1 or greater. If larger ratios are used, then project costs tend to decrease since less wells and equipment are needed. (Specification, page 72, lines 9-23)

In FIG. 58, production well 2701 and heat source 2712 may be located at the apices of a triangular grid. The triangular grid may be an equilateral triangular grid with sides of length, s. Production wells 2701 may be spaced at a distance of about 1.732(s). Production well 2701 may be disposed at a center of a hexagonal pattern with one ring 2713 of six heat sources 2712. Each heat source 2712 may provide substantially equal amounts of heat to three production wells. Therefore, each ring 2713 of six heat sources 2712 may contribute approximately two equivalent heat sources per production well 2701. (Specification, page 201, lines 11-17)

Thus, Applicant submits that "about 7 heaters" in amended claims 1763 and 1802 does not refer to an integer number of heaters, but rather to an effective number of heaters per production well. Applicant therefore respectfully requests removal of the rejection of claims 1763 and 1802.

The Examiner objected to Applicant's definition of "hydrocarbon." The Examiner states: "While applicant may be his or her own lexicographer, a term in a claim may not be given a meaning repugnant to the usual meaning of the that term....Applicant's vague definition of 'hydrocarbon' is much broader than the accepted meaning of the term and this makes it impossible for one of ordinary skill in the art to ascertain the scope of the claims, which include the term 'hydrocarbon'." (Office Action, pages 5-6) Applicant respectfully disagrees.

Applicant respectfully submits that Applicant has used an accepted meaning of the term "hydrocarbon" as defined by one of ordinary skill in the art. Support for this definition can be found in references within and associated with the art of the petroleum industry. For example, a reference within the art gives the following definition: "**Hydrocarbons**: molecules formed primarily by carbon and hydrogen atoms." (Hyne, N. J. *Geology for Petroleum Exploration,*

Drilling, and Production, 1984, McGraw-Hill Book Company, pg. 264) The Specification (page 38, paragraph beginning on line 14) has been amended for clarification. Applicant therefore respectfully requests removal of the rejection of Applicant's definition of the term "hydrocarbon."

The Examiner states: "Claims 1736 and 1775 call for the heating energy to be equal to or less than Pwr. Pwr is defined using an ideal equation for heating. Since this equation fails to take into account the endothermic nature of pyrolysis reactions, and heat loss to adjacent formations; it is not clear how the heating energy can be equal to or less than Pwr." (Office Action, page 6) Applicant respectfully disagrees with the rejection. Applicant has amended claims 1736 and 1775 for clarification. Applicant respectfully submits the amendments to these claims do not substantively change the scope of the claims.

The Examiner rejected claims 1750 and 1789 as being unclear regarding "non-condensable component." Applicant respectfully disagrees with the rejection. Support for "non-condensable component" is found in Applicant's Specification, which states:

> Hydrocarbons in the produced fluids may include a mixture of a number of different components, some of which are condensable and some of which are not. The fraction of non-condensable hydrocarbons within the produced fluid may be altered and/or controlled by altering, controlling, and/or maintaining a temperature within a pyrolysis temperature range in a heated portion of the hydrocarbon containing formation. Additionally, the fraction of non-condensable hydrocarbons within the produced fluids may be altered and/or controlled by altering, controlling, and/or maintaining a pressure within the heated portion. In some embodiments, surface facilities may be configured to separate condensable and non-condensable hydrocarbons of a produced fluid. (Specification, page 141, lines 6-14)

In addition, the Examiner rejected claims 1750 and 1789 as being unclear regarding a "benchmark temperature and pressure." (Office Action, page 7) Applicant has amended claims 1750 and 1789 to include conditions of 25 °C and one atmosphere absolute pressure, as described in the definition of "non-condensable hydrocarbons" on page 42, lines 13-16 of the Specification.

The Examiner rejected claims 1761 and 1800 as unclear regarding "substantially uniformly increasing a permeability." Applicant respectfully disagrees. Support for claims 1761 and 1800 is found in the Specification, which states:

> In an embodiment, a permeability of a selected section within a heated portion of a coal formation may be substantially uniform. For example, heating by conduction may be substantially uniform, and thus a permeability created by conductive heating may also be substantially uniform. In the context of this patent "substantially uniform permeability" means that the assessed (e.g., calculated or estimated) permeability of any selected portion in the formation does not vary by more than a factor of 10 from the assessed average permeability of such selected portion. (Specification, page 151, lines 20-26)

> Heating the portion of a coal formation, as described in any of the above embodiments, may substantially uniformly increase a porosity of a selected section within the heated portion. In the context of this patent "substantially uniform porosity" means that the assessed (e.g., calculated or estimated) porosity of any selected portion in the formation does not vary by more than about 25 % from the assessed average porosity of such selected portion. (Specification, page 153, lines 4-9)

Claims 1729 and 1768 were rejected as being unclear regarding "a pyrolysis temperature range." Applicant has amended claims 1729 and 1768 for clarification. Support for this amendment can be found in Applicant's Specification, which states: "In an alternative embodiment, a pyrolysis temperature range may include temperatures between about 270 °C to about 400 °C." (Specification, page 46, lines 14-15) Applicant submits that the amendments to these claims do not broaden the scope of the claims.

The Examiner states: "Claims 1735 and 1774 are unclear regarding 'during pyrolysis'." (Office Action, page 6) Claims 1735 and 1774 have been amended for clarification. Applicant submits that the amendments to these claims do not broaden the scope of the claims.

E. The Claims Are Not Anticipated By Tsai et al. Pursuant To 35 U.S.C. § 102(b)

The Examiner rejected claims 1727, 1729, 1732, 1733, 1737, 1753, 1760-1762, 1766, 1768, 1771, 1776, 1792, and 1799-1801 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,299,285 to Tsai et al. (hereinafter "Tsai") Applicant respectfully disagrees with these rejections.

The standard for "anticipation" is one of fairly strict identity. To anticipate a claim of a patent, a single prior source must contain all the claimed essential elements. *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 231 U.S.P.Q.81, 91 (Fed.Cir. 1986); *In re Donahue*, 766 F.2d 531, 226 U.S.P.Q. 619, 621 (Fed.Cir. 1985)

Amended claims 1727 and 1766 describe a combination of features including, but not limited to: "providing heat from one or more heaters to at least a portion of the formation." Support for amendments to the claims is found at least in the Specification as follows:

> A "heater" is generally defined as any system configured to generate heat in a well or a near wellbore region. A "unit of heat sources" refers to a minimal number of heat sources that form a template that is repeated to create a pattern of heat sources within a formation. For example, a heater may generate heat by burning a fuel external to or within a formation such as surface burners, flameless distributed combustors, and natural distributed combustors, as described in embodiments herein. (Specification, p. 40, lines 6-11)
>
> Heat sources 100 may include, for example, electrical heaters such as insulated conductors, conductor-in-conduit heaters, surface burners, flameless distributed combustors, and/or natural distributed combustors. Heat sources 100 may also include other types of heaters. (Specification, p. 56, lines 14-18)

Applicant submits that Tsai does not appear to teach or suggest at least the above-mentioned features, in combination with the other features of the claims. Tsai states: "the oxidizing gas is injected into the injection hole at an appropriate rate and the fire is started in the coal bed at the injection well." (column 2, lines 30-33) Applicant respectfully submits that Tsai does not appear to teach or suggest providing heat from one or more heaters to at least a portion of the formation.

Applicant submits that the cited art does not appear to teach the combination of features of claims 1727 and 1766 including, but not limited to, heaters. Applicant submits that claims 1727 and 1766 are allowable over the cited art.

Amended claims 1729 and 1768 describe a combination of features including: "further comprising maintaining a temperature within the part of the formation within a pyrolysis temperature range from about 270 °C to about 400 °C." Applicant submits that the amended features of claims 1729 and 1768 are supported by Applicant's Specification on at least page 80 (paragraph beginning on line 17) and page 122 (paragraph beginning on line 22).

The Examiner states: "the Tsai reference teaches a pyrolysis temperature range within a section of the formation (see col. 4, line 54). (Office Action, pages 8 and 9) Applicant submits that Tsai does not appear to teach a pyrolysis temperature range in a part of the formation. Tsai appears to teach heating air to within a range of temperatures, which may vaporize some moisture from the coal. Tsai states:

> In general, we prefer that the temperature of the heated air be a maximum of about 350° C. and most prefer that the maximum temperature be about 300° C. The range of about 150° C. to about 300° C. is a particularly suitable operating range. (Tsai, column 3, lines 41-45)
>
> Initially, there is a vaporization of moisture from the coal and a loss of some volatile carbonaceous material. Some of this may be the result of a minor pyrolysis of the coal. (Tsai, column 4, lines 51-54)

Applicant submits that, for at least the reasons cited above, the features of claims 1729 and 1768, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1732 and 1771 describe the feature of a flameless combustor. Claims 1733 and 1772 describe the feature of a natural distributed combustor. The Examiner states:

> With regards to claim 1732; the Tsai reference teaches a flameless combustor (see col. 2, line 32). (Office Action, page 8)

> With regards to claim 1733; the Tsai reference teaches a natural distributed combustor (see col. 2, line 32). (Office Action, page 8)
>
> With regards to claim 1771; the Tsai reference teaches a flameless combustor (see col. 2, line 32). (Office Action, page 9)
>
> With regards to claim 1772; the Tsai reference teaches a natural distributed combustor (see col. 2, line 32). (Office Action, page 9)

Applicant's Specification teaches:

> Flameless combustion may be accomplished by preheating a fuel and combustion air to a temperature above an auto-ignition temperature of the mixture. The fuel and combustion air may be mixed in a heating zone to combust. In the heating zone of the flameless combustor, a catalytic surface may be provided to lower the auto-ignition temperature of the fuel and air mixture. (Specification, page 4, lines 2-6)
>
> As used herein, the phrase "natural distributed combustor" generally refers to a heater that uses an oxidant to oxidize at least a portion of the carbon in the formation to generate heat, and wherein the oxidation takes place in a vicinity proximate to a wellbore. Most of the combustion products produced in the natural distributed combustor are removed through the wellbore. (Specification, page 40, lines 19-23)

Tsai does not appear to teach a heater such as a natural distributed combustor or a flameless combustor. Tsai appears to teach starting a fire in a coal bed. Tsai states: "the oxidizing gas is injected into the injection hole at an appropriate rate and the fire is started in the coal bed at the injection well." (Tsai, column 2, lines 31-34)

Applicant submits that the features of claims 1732 and 1733 and claims 1771 and 1772, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art for at least the reasons cited above.

Claims 1737 and 1776 describe a combination of features including: "wherein allowing the heat to transfer comprises transferring heat substantially by conduction."

The Examiner states: "the Tsai reference does not explicitly teach the transferring by conduction; however this is inherent in a solid substance such as coal. Even though the bulk of the heating in the Tsai method may be done by convection; it is apparent that some unfractured coal must remain, and thus the [sic] allowing heat to transfer comprises transferring heat substantially by conduction." (Office Action, pages 8 and 9) Applicant respectfully disagrees with this rejection.

Tsai appears to teach increasing permeability by fracturing a coal bed to allow the hot air to permeate the formation. Tsai states:

> This link or channel between wells can be naturally occurring permeability in the coal seam involving cracks, fissures and the like. But since naturally occurring paths of suitable gas flow capacity are rare, it is generally necessary by some suitable means to significantly enhance a naturally occurring path or it may be necessary to produce an artificial path for high volume, low pressure gas flow between the injection and production wells. One solution involves the fracturing of the coal bed by injecting under substantial pressure an aqueous mixture containing suitable entrained particles as propping agents t open up fracture planes and channels in which the particles settle out to prop the fractures open when the pressure is released. Another method involves the directional drilling of one or more holes through the coal bed, generally along the bottom portion of the bed, between the injection and production holes. Other linking methods or combinations of linking methods can be used to obtain the linkage between the wells. (Tsai, column 2, lines 9-29)

Furthermore, Tsai appears to teach in situ combustion and gasification in an area between injection wells and production wells to produce a combustible gas from the formation. Tsai discloses:

> Air is heated to a temperature of about 250° C. and is injected into the injection well at a pressure of approximately 500 psi (35.2 kg/cm^2) and at a rate of about 300 ft^3/min (8.5 m^3/min) (standardized to one atmosphere and 15.6° C.). Injection is continued at this rate for five days. Combustion air at ambient temperature is now injected into the injection hole at a pressure of 50 psi (3.51 kg/cm^2) and at a rate of 1,500 ft^3/min (42.5 m^3/min) (standardized to one atmosphere and 15.6° C.), and a fire is ignited in the coal at the bottom of the injection well. After the underground combustion stabilizes, a combustible product gas is obtained at the production well. (Tsai, column 7, line 62-column 8,

line 17)

Applicant submits that it is not inherent that the invention of Tsai would conduct heat into the formation and heat the formation enough to produce a mixture from the formation. Applicant submits that portions of the aforementioned rejection appears to be set forth in facts within the personal knowledge of the Examiner. Applicant respectfully submits that the cited art does not appear to teach or suggest the features of claims 1737 and 1776 in combination with the features of independent claims 1727 and 1766, respectively.

Amended claims 1753 and 1792 describe features including: "controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bars absolute." The Examiner states: "the Tsai reference teaches the pressure greater than 2.0 bar." (Office Action, pages 8 and 9)

Applicant submits that Tsai does not appear to teach controlling pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bars absolute. Tsai appears to teach or suggest injecting air at a pressure of approximately 500 psi or approximately 50 psi. Tsai states:

> Air is heated to a temperature of about 250° C. and is injected into the injection well at a pressure of approximately 500 psi (35.2 kg/cm^2) and at a rate of about 300 ft^3/min (8.5 m^3/min) (standardized to one atmosphere and 15.6° C.). Injection is continued at this rate for five days. Combustion air at ambient temperature is now injected into the injection hole at a pressure of 50 psi (3.51 kg/cm^2) and at a rate of 1,500 ft^3/min (42.5 m^3/min) (standardized to one atmosphere and 15.6° C.), and a fire is ignited in the coal at the bottom of the injection well. After the underground combustion stabilizes, a combustible product gas is obtained at the production well. (Tsai, column 7, line 62-column 8, line 17)

Applicant submits that the features of amended claims 1753 and 1792, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Amended claims 1760 and 1799 describe a combination of features including: "wherein allowing the heat to transfer comprises increasing a permeability of a majority of the part of the formation to greater than about 100 millidarcy." Amended claims 1761 and 1800 describe a combination of features including: "wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation."

The Examiner states: "the Tsai reference teaches the permeability greater than about 100 md in table 1. The uniform increase in permeability is inherent." (Office Action, pages 8 and 10) Applicant respectfully disagrees with the rejection.

Applicant submits that Tsai does not appear to teach increasing at least a majority of the part of the formation to greater than 100 millidarcy. Applicant further submits that Tsai does not appear to teach substantially uniformly increasing a permeability of at least a majority of the part of the formation. Tsai appears to teach heating the core and recording the permeability. Tsai also does not appear to teach a substantially uniform increase in the permeability.

Tsai states: "The initial permeability of the core was 2.0, after two days it was 27.5, after three days is was 77.2 and after four days it was 107 as reported in Table I." (Tsai, column 7, lines 11-14) Referring to TABLE I, Tsai appears to teach a permeability of 107 md for Ex. 6 and a permeability of 148 md for Ex. 7, in which the axis of the core was perpendicular to the bedding plane. Tsai does not appear to teach or suggest at least the feature of wherein allowing the heat to transfer comprises substantially uniformly increasing a permeability of a majority of the part of the formation.

Thus, Applicant submits that the features of claims 1760 and 1761 and claims 1799 and 1800, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1762 and 1801 describe a combination of features including: "controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by the Fischer Assay." Applicant's Specification teaches: "The Fischer Assay is a standard method

which involves heating a sample of a hydrocarbon containing layer to approximately 500 °C in one hour, collecting products produced from the heated sample, and quantifying the amount of products produced." (Specification, page 56, lines 5-8)

The Examiner states: "although the Tsai reference fails to explicitly disclose a Fischer Assay; it is apparent that the disclosed process will yield greater than 60%." (Office Action, pages 8 and 10)

Applicant submits that Tsai does not appear to teach a yield greater than 60%. Tsai appears to teach a volatile content (i.e., a yield) of 31 percent that contains greater than 84 percent carbon. Tsai states: "a volatile content of 31 percent, an ash content of 2.12 percent and a heating value of 15,200 Btu/lb (8,460 kcal/kg). Elemental analysis showed 84.73 percent carbon, 4.63 percent hydrogen, 3.1 percent oxygen and 0.59 percent sulfur. Nitrogen was not determined." (Tsai, column 6, lines 46-51)

Applicant submits that the Examiner is extending the teaching of Tsai to increase the yield from 31% to 60%. Applicant submits that the increase in yield is not inherent to Tsai. Therefore, Applicant submits that the features of claims 1762 and 1801, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Applicant submits that portions of the aforementioned rejection appears to be set forth in facts within the personal knowledge of the Examiner. Applicant therefore believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicant requests this rejection be removed.

F. The Claims Are Not Obvious Over Tsai Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1728, 1730, 1731, 1738-50, 1754, 1755, 1767, 1769, 1770, 1777-1789, 1793, and 1794 under 35 U.S.C. § 103(a) as being unpatentable over Tsai. Applicant

respectfully disagrees.

In order to reject a claim as obvious, the Examiner has the burden of establishing a *prima facie* case of obviousness. *In re Warner et al.*, 379 F.2d 1011, 154 USPQ 173, 177-178 (CCPA 1967). To establish a *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP § 2143.03.

Amended claims 1728 and 1767 describe a combination of features including: "wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least the two heaters pyrolyzes at least some hydrocarbons within the part of the formation."

The Examiner states: "the Tsai reference fails to explicitly teach the superposition of heat sources. It is apparent that one of ordinary skill in the art would know that the heat sources should be space to substantially heat the entire formation." (Office Action, page 10)

Applicant's Specification teaches:

> In some embodiments, a plurality of heated portions may exist within a unit of heat sources. A unit of heat sources refers to a minimal number of heat sources that form a template that may be repeated to create a pattern of heat sources within the formation. The heat sources may be located within the formation such that superposition (overlapping) of heat produced from the heat sources is effective. For example, as illustrated in FIG. 7, transfer of heat from two or more heat sources 330 results in superposition of heat 332 to be effective within an area defined by the unit of heat sources. Superposition may also be effective within an interior of a region defined by two, three, four, five, six or more heat sources. For example, an area in which superposition of heat 332 is effective includes an area to which significant heat is transferred by two or more heat sources of the unit of heat sources. An area in which superposition of heat is effective may vary depending upon, for example, the spacings between heat sources. (Specification, page 63, lines 8-19)

> In some embodiments, superposition (e.g., overlapping) of heat from one or more heat sources may result in substantially uniform heating of a portion of a hydrocarbon containing formation. Since formations during heating will typically

> have temperature profiles throughout them, in the context of this patent "substantially uniform" heating means heating such that the temperatures in a majority of the section do not vary by more than 100 °C from the assessed average temperature in the majority of the selected section (volume) being treated. (Specification, page 152, lines 7-13)

Tsai appears to teach in situ combustion and gasification in an area between injection wells and production wells to produce a combustible gas from the formation. Tsai states:

> The spacing, orientation and linking of wells into a predetermined pattern for an orderly, progressive burn of the coal deposit for maximum economy in recovery of the coal's heating values is a known art. (Tsai, column 1, line 69-column 2, line 4)

> Air is heated to a temperature of about 250° C. and is injected into the injection well at a pressure of approximately 500 psi (35.2 kg/cm^2) and at a rate of about 300 ft^3/min (8.5 m^3/min) (standardized to one atmosphere and 15.6° C.). Injection is continued at this rate for five days. Combustion air at ambient temperature is now injected into the injection hole at a pressure of 50 psi (3.51 kg/cm^2) and at a rate of 1,500 ft^3/min (42.5 m^3/min) (standardized to one atmosphere and 15.6° C.), and a fire is ignited in the coal at the bottom of the injection well. After the underground combustion stabilizes, a combustible product gas is obtained at the production well. (Tsai, column 7, line 62-column 8, line 17)

Applicant submits that, while superposition of heat may be achieved by various heat source configurations, the Examiner is extending the teaching of Tsai by suggesting that "[a]ny configuration of heat sources that provides heat to the entire formation" would confer the unexpected advantages of superposition of heaters described above in the Applicant's Specification. Thus, Applicant submits the features of claims 1728 and 1767, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Amended claims 1730 and 1769 describe a combination of features including: "wherein the one or more heaters comprise electrical heaters." The features of claims 1730 and 1769, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Amended claims 1731 and 1770 describe a combination of features including: "wherein the one or more heaters comprise surface burners." The features of claims 1731 and 1770, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Amended claims 1738 and 1777 describe a combination of features including: "wherein providing heat from the one or more heaters comprises heating the part of the formation such that a thermal conductivity of at least a portion of the part of the formation is greater than about 0.5 W/(m °C)." The features of claims 1738 and 1777, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Tsai appears to teach a temperature less than the softening temperature of coal. Tsai does not appear to teach or suggest that the thermal conductivity of the part of the formation is greater than about 0.5 W/(m °C) or that uniform heating is desired. Tsai states:

> Since the injection of the heated air should itself not cause the coal to swell, the maximum temperature of the injected air can be up to but not the same as the temperature at which the coal begins to soften....The range of about 150° C. to about 300° C is a particularly suitable operating range. (Tsai, column 3, lines 32-45)

Whether or not "a particular combination might be 'obvious to try' is not a legitimate test of patentability." *Id.* at 1599, citing *In re Geiqer*, 815 F.2d 868, 688, 2 USPQ2d 1276, 1278 (Fed. Cir. 1987) and *In re Goodwin*, 576 F.2d 375, 377, 198 USPQ 871, 881 (CCPA 1981). Consequently, it is not permissible for the Examiner to "use hindsight reconstruction to pick and chose among isolated disclosures in the prior art to deprecate the claimed invention." Id. at 1600.

The Examiner states: "With regards to claims 1739-1750, 1754, 1755, 1778-1789, 1793, and 1794; the nature of hydrocarbons produced from such heating is highly variable and dependent upon many factors, not least of which is the characteristics of the coal." (Office

Action, page 11) Applicant respectfully disagrees. Applicant submits that many of the dependent claims are separately patentable in combination with the features of the independent claims.

Claims 1739 and 1778 describe a combination of features including: "wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°." Applicant's Specification teaches: "'Condensable hydrocarbons' means the hydrocarbons that condense at 25 °C at one atmosphere absolute pressure. Condensable hydrocarbons may include a mixture of hydrocarbons having carbon numbers greater than 4." (Specification, page 42, lines 11-13)

Tsai does not appear to teach condensable hydrocarbons having an API gravity of at least 25°. Tsai appears to teach a product gas including methane. Tsai states: "The net result is a combustible product gas comprising carbon monoxide, hydrogen and some methane as its principle combustibles." (Tsai, column 5, lines 55-57)

Applicant submits that the features of claims 1739 and 1778, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1740 and 1779 describe a combination of features including: "wherein the produced mixture comprises condensable hydrocarbons, and wherein about 0.1 % by weight to about 15 % by weight of the condensable hydrocarbons are olefins." For at least the reasons cited above, Applicant submits the features of claims 1740 and 1779, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1741 and 1780 describe a combination of features including: "wherein the produced mixture comprises non-condensable hydrocarbons, and wherein a molar ratio of ethene to ethane in the non-condensable hydrocarbons ranges from about 0.001 to about 0.15." The

features of claims 1741 and 1780, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1742 and 1781 describe a combination of features including: "wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is nitrogen." The features of claims 1742 and 1781, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1743 and 1782 describe a combination of features including: "wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is oxygen." The features of claims 1743 and 1782, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1744 and 1783 describe a combination of features including: "wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is sulfur." The features of claims 1744 and 1783, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1745 and 1784 describe a combination of features including: "wherein the produced mixture comprises condensable hydrocarbons, wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons comprise oxygen containing compounds, and wherein the oxygen containing compounds comprise phenols." The features of claims 1745 and 1784, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1746 and 1785 describe a combination of features including: "wherein the produced mixture comprises condensable hydrocarbons, and wherein greater than about 20 % by weight of the condensable hydrocarbons are aromatic compounds." The features of claims 1746

and 1785, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1747 and 1786 describe a combination of features including: "wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 5 % by weight of the condensable hydrocarbons comprises multi-ring aromatics with more than two rings." The features of claims 1747 and 1786, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1748 and 1787 describe a combination of features including: "wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 0.3 % by weight of the condensable hydrocarbons are asphaltenes." The features of claims 1748 and 1787, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1749 and 1788 describe a combination of features including: "wherein the produced mixture comprises condensable hydrocarbons, and wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons are cycloalkanes." The features of claims 1749 and 1788, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Amended claims 1750 and 1789 describe a combination of features including: "wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure." The features of claims 1750 and 1789, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1754 and 1793 describe a combination of features including: "controlling formation conditions to produce the mixture, wherein a partial pressure of H_2 within the mixture is greater than about 0.5 bar." The features of claims 1754 and 1793, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1755 and 1794 describe a combination of features including: "wherein the partial pressure of H_2 within the mixture is measured when the mixture is at a production well." The features of claims 1755 and 1794, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Applicant submits that portions of the aforementioned rejections appear to be set forth in facts within the personal knowledge of the Examiner. Applicant therefore believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicant requests these rejections be removed.

G. The Claims Are Not Obvious Over Tsai In View Of Elkins Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1734 and 1773 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 2,734,579 to Elkins (hereinafter "Elkins"). Applicant respectfully disagrees.

Amended claims 1734 and 1773 describe a combination of features including: "controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure."

Elkins does not appear to teach or suggest controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of

temperature, or the temperature is controlled as a function of pressure. Elkins appears to teach or suggest changing the pressure and/or concentration of the injected gas pressure to control the temperature. Elkins states:

> Control of the temperature within the reaction zone can be maintained in several ways. The increase in volume of oxygen-containing gas by application of higher injection gas pressure will increase this temperature. ...To keep the temperature from becoming too high, it is possible to dilute the air with inert gas, for example, by separating the inert gaseous products of combustion (principally oxides of nitrogen and carbon) from the produced hydrocarbons, and introducing it into the injection stream....Decreasing the injection gas pressure also decreases the combustion zone temperature. (Elkins, column 3, lines 26-46)

Applicant respectfully submits that the features of claims 1734 and 1773, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by Tsai in view of Elkins.

H. The Claims Are Not Obvious Over Tsai In View Of Kasevich et al. Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1735, 1736, 1774, and 1775 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 4,457,365 to Kasevich et al. (hereinafter "Kasevich"). Applicant respectfully disagrees.

Amended claims 1735 and 1774 describe a combination of features including, but not limited to: "controlling the heat such that an average heating rate of the part of the formation is less than about 1 °C per day during pyrolysis within a pyrolysis temperature range of about 270 °C to about 400 °C."

Kasevich does not appear to teach or suggest the features of the claims. Referring to Figure 3, Kasevich appears to teach a heating rate of 50 °C/month, which may correspond to an average heating rate of about 1.6 °C/day. Kasevich states:

Thus, if the kerogen were heated from 150 °C. to 500 °C. at the rate of 50

> °C./month, the absorption rate would approximate that of curve 114 [in Figure 3], while more rapid heating rates would produce curves 120, 122 and 124 for heating rates of 50 °C. per month, 50 °C./day, 50 °C./hour and 50 °C./minute, respectively. (Kasevich, column 8, lines 57-62)

The Examiner states, however: "It is apparent that when the temperature reaches its highest point (the point at which pyrolysis occurs) the rate of increase would be at the slowest; thus it would be less than about 1 °C/day." (Office Action, page 13)

Applicant respectfully submits that the Examiner appears to be using personal knowledge to extend the teaching of Kasevich. Applicant submits that the cited art does not appear to teach or suggest the features of claims 1735 and 1774 in combination with the features of independent claims 1727 and 1766, respectively.

Amended claims 1736 and 1775 and describe a combination of features including but not limited to: "wherein heating energy/day (*Pwr*) provided to the selected volume is equal to or less than $h*V*Cv*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day."

Kasevich does not appear to teach or suggest using a desired heating rate to calculate a maximum amount of heating energy/day to be applied to a selected volume of a formation. Applicant submits that Kasevich, in combination with Tsai, does not appear to teach or suggest the features of claims 1736 and 1775 in combination with the features of independent claims 1727 and 1766, respectively.

Applicant further submits that Tsai, in combination with Kasevich, does not teach or suggest the features of claims 1735 and 1736 and claims 1774 and 1775 in combination with independent claims 1727 and 1766, respectively. Kasevich appears to teach heating kerogen in oil shale (not coal) with electric heaters, while Tsai appears to teach burning coal.

Kasevich states: "this invention provides for heating kerogen in oil shale with electric fields having frequency components in the range between 100 kilohertz and 100 megahertz

where dry oil shale is selectively heated, with kerogen-rich regions absorbing energy from said fields at substantially higher rates than kerogen-lean regions." (Kasevich, column 2, lines 9-15)

Tsai states: "This invention relates to the in situ combustion and gasification of a swelling bituminous coal by the injection of air for combustion into the coal bed from one or more injection holes and the production of a combustible gas from one or more production holes." (Tsai, column 1, lines 6-10)

MPEP, 8th Ed., page 2100-126, states: "Whether an art is predictable or whether the proposed modification or combination of the prior art has a reasonable expectation of success is determined at the time the invention was made." *Ex parte Erlich*, 3 USPQ2d 1011 (Bd. Pat. App. & Inter. 1986). Applicant respectfully submits that the features of the electric field heating method of Kasevich for an oil shale formation would not be suitable for modifying the in situ combustion process of Tsai for a coal formation to produce features of Applicant's claims. Thus, Applicant submits that the features of claims 1735 and 1736 and claims 1774 and 1775, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by Tsai in view of Kasevich.

I. The Claims Are Not Obvious Over Tsai In View of Stoddard et al. Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1751, 1752, 1790, and 1791 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 4,463,807 to Stoddard et al. (hereinafter "Stoddard"). Applicant respectfully disagrees.

Claims 1751 and 1790 describe a combination of features including: "wherein the produced mixture comprises ammonia, and wherein greater than about 0.05% by weight of the produced mixture is ammonia."

Stoddard does not appear to teach a produced mixture with an ammonia concentration greater than 0.05% by weight. Stoddard appears to teach excluding ammonia from a georeactor

and from an aquifer. Stoddard states: "A seal against water incursion serves two purposes: water is excluded from the georeactor and the processes underway, and water soluble products of reactions (phenols, ammonia and the like) are excluded from the aquifer." (Stoddard, column 3, lines 28-31)

Applicant submits that Stoddard, in combination with Tsai, does not appear to teach or suggest the features of claims 1751 and 1790 in combination with the features of independent claims 1727 and 1766, respectively.

Claims 1752 and 1791 describe a combination of features including: "wherein the produced mixture comprises ammonia, and wherein the ammonia is used to produce fertilizer." Applicant submits that the features of claims 1752 and 1791, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

J. The Claims Are Not Obvious Over Tsai In View of Gregoli et al. Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1756-1759 and 1795-1798 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 6,016,867 to Gregoli et al. (hereinafter "Gregoli"). Applicant respectfully disagrees.

Claims 1756 and 1795 describe a combination of features including: "altering a pressure within the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25."

Gregoli does not appear to teach or suggest at least the feature of "altering a pressure within the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25" in combination with the other features of the claims. Gregoli appears to teach converting higher molecular weight components into lower molecular weight components. Gregoli states:

> Heavy hydrocarbons 207 in the reservoir 27 are heated by the hot injected fluids which, in the presence of hydrogen, initiate hydrovisbreaking reactions. These reactions upgrade the quality of the hydrocarbons by converting their higher molecular-weight components into lower molecular-weight components which have less density, lower viscosity, and greater mobility within the reservoir than the unconverted hydrocarbons. The hydrocarbons subjected to hydrovisbreaking reactions and additional virgin hydrocarbons flow into the perforations 203 of the casing 202 of the production-well borehole 201, propelled by the pressure of the injected fluids. (Gregoli, column 12, lines 35-46)

Applicant submits that the features of claims 1756 and 1795, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Claims 1757 and 1796 describe a combination of features including: "controlling formation conditions by recirculating a portion of hydrogen from the mixture into the formation." Gregoli does not appear to teach or suggest at least the feature of "controlling formation conditions by recirculating a portion of hydrogen from the mixture into the formation" in combination with the other features of the claims. Gregoli appears to teach feeding hydrogen to a downhole combustion unit. Gregoli states:

> Preferably, a stoichiometric mixture of hydrogen and oxygen is initially fed to the downhole combustion unit 206 so that the sole product of combustion is superheated steam. As the reservoir becomes heated to the level necessary for the occurrence of hydrovisbreaking reactions, it is preferable that a stoichiometric excess of hydrogen be fed to the downhole combustion unit during its operation - or that hydrogen be injected into the reservoir along with superheated steam. (Gregoli, column 14, lines 28-38)

Gregoli further discloses:

> The hydrocarbons subjected to the hydrovisbreaking reactions and additional virgin hydrocarbons, propelled by the pressure of the injected fluids, flow into the vertical fractures 211 of the reservoir 27 and thence into the horizontal producing wells intersecting the fractures, where they are recovered along with the injected fluids using conventional oil-field technology. (Gregoli, column 15, lines 26-33)

Applicant submits that the features of claims 1757 and 1796, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Amended claims 1758 and 1797 describe a combination of features including: "providing hydrogen (H_2) to the part of the formation to hydrogenate hydrocarbons within the part of the formation; and heating a portion of the part of the formation with heat from hydrogenation." Gregoli does not appear to teach or suggest at least the feature of "providing hydrogen (H_2) to the part of the formation to hydrogenate hydrocarbons within the part of the formation; and heating a portion of the part of the formation with heat from hydrogenation" in combination with the other features of the claims. Gregoli appears to teach providing superheated steam. Gregoli states:

> The superheated steam resulting from using partially saturated steam to absorb the heat of combustion in the combustion unit and the hot reducing gases exiting the combustion unit are then injected into the formation to provide the thermal energy and reactants required for the process. (Gregoli, column 8, lines 54-58)

Applicant submits that the features of claims 1758 and 1797, in combination with the features of independent claims 1727 and 1766, respectively, for at least the reasons cited above, do not appear to be taught or suggested by the cited art.

Claims 1759 and 1798 describe a combination of features including: "producing hydrogen and condensable hydrocarbons from the formation; and hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen." The features of claims 1759 and 1798, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

K. The Claims Are Not Obvious Over Tsai In View Of Van Meurs et al. Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1763, 1764, 1802, 1803, 5396, and 5397 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view of U.S. Patent No. 4,886,118 to Van Meurs et al.

(hereinafter "Van Meurs"). Applicant respectfully disagrees.

Amended claims 1763 and 1802 describe a combination of features including: "wherein producing the mixture comprises producing the mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well." The features of claims 1763 and 1802, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

Amended claims 5396 and 5397 describe a combination of features including: "wherein at least about 20 heaters are disposed in the formation for each production well." The features of claims 5396 and 5397, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

The Examiner states: "The Tsai reference fails to teach the at least about 7 heat sources for each production well....The Van Meurs reference teaches a similar in situ heating system, and further teaches that six or twelve heat sources for each production well significantly increases the production....It would have been obvious to one of ordinary skill in the art at the time of the invention to have used at least about 20 heat sources for each production well...." (Office Action, pages 15 and 16) Applicant respectfully disagrees with the rejections.

Referring to FIG. 9, Applicant's Specification teaches:

> Unit cell 404 will often include a number of heat sources 400 disposed within a formation around each production well 402. An area of unit cell 404 may be determined by midlines 406 that may be equidistant and perpendicular to a line connecting two production wells 402. Vertices 408 of the unit cell may be at the intersection of two midlines 406 between production wells 402. Heat sources 400 may be disposed in any arrangement within the area of unit cell 404. For example, heat sources 400 may be located within the formation such that a distance between each heat source varies by less than approximately 10 %, 20 %, or 30 %. In addition, heat sources 400 may be disposed such that an approximately equal space exists between each of the heat sources. Other arrangements of heat sources 400 within unit cell 404, however, may be used depending on, for example, a heating rate of each of the heat sources. A ratio of heat sources 400 to production wells 402 may be determined by counting the

number of heat sources 400 and production wells 402 within unit cell 404, or over the total field.

FIG. 9 illustrates an embodiment of unit cell 404. Unit cell 404 includes heat sources 400 and production wells 402. Unit cell 404 may have six full heat sources 400a and six partial heat sources 400b. Full heat sources 400a may be closer to production well 402 than partial heat sources 400b. In addition, an entirety of each of the full heat sources 400 may be located within unit cell 404. Partial heat sources 400b may be partially disposed within unit cell 404. Only a portion of heat source 400b disposed within unit cell 404 may be configured to provide heat to a portion of a hydrocarbon containing formation disposed within unit cell 404. A remaining portion of heat source 400b disposed outside of unit cell 404 may be configured to provide heat to a remaining portion of the hydrocarbon containing formation outside of unit cell 404. Therefore, to determine a number of heat sources within unit cell 404 partial heat source 400b may be counted as one-half of full heat sources 400. In other unit cell embodiments, fractions other than 1/2 (e.g. 1/3) may more accurately describe the amount of heat applied to a portion from a partial heat source.

The total number of heat sources 400 in unit cell 404 may include six full heat sources 400a that are each counted as one heat source, and six partial heat sources 400b that are each counted as one half of a heat source. Therefore, a ratio of heat sources 400 to production wells 402 in unit cell 404 may be determined as 9:1. A ratio of heat sources to production wells may vary, however, depending on, for example, the desired heating rate of the hydrocarbon containing formation, the heating rate of the heat sources, the type of heat source, the type of hydrocarbon containing formation, the composition of hydrocarbon containing formation, the desired composition of the produced fluid, and/or the desired production rate. Providing more heat sources wells per unit area will allow faster heating of the selected portion and thus hastening the onset of production, however more heat sources will generally cost more money to install. An appropriate ratio of heat sources to production wells may also include ratios greater than about 5:1, and ratios greater than about 7:1. In some embodiments an appropriate ratio of heat sources to production wells may be about 10:1, 20:1, 50:1 or greater. If larger ratios are used, then project costs tend to decrease since less wells and equipment are needed. (Specification page 71, line 12-page 72, line 23)

Van Meurs does not appear to teach positioning heaters such that a ratio of at least about 20:1 heaters to production wells is achieved. Van Meurs appears to teach contiguous seven-spot or thirteen spot patterns. Van Meurs states: "However, the present invention is preferably employed in a series of contiguous seven- or thirteen-spot patterns." (Van Meurs, column 8, lines 19-21)

Applicant submits that the features of claims 5396 and 5397, in combination with the features of independent claims 1727 and 1766, respectively, are patentable over Tsai in view of Van Meurs.

Amended claims 1764 and 1803 describe a combination of features including: "providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern." The features of claims 1764 and 1803, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

L. The Claims Are Not Obvious Over Tsai In View Of Van Meurs And In Further View of Salomonsson Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 1765 and 1804 under 35 U.S.C. § 103(a) as being unpatentable over Tsai in view Van Meurs and in further view of U.S. Patent No. 2,914,309 to Salomonsson (hereinafter "Salomonsson"). Applicant respectfully disagrees.

Amended claims 1765 and 1804 describe a combination of features including: "providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units." The features of claims 1765 and 1804, in combination with the features of independent claims 1727 and 1766, respectively, do not appear to be taught or suggested by the cited art.

M. Summary

Applicant submits that all claims are in condition for allowance. Favorable consideration is respectfully requested.

A Fee Authorization in the amount of $180.00 is enclosed to cover the fee for submission of an Information Disclosure Statement. If any extension of time is needed, Applicant requests the proper extension of time be granted. If any additional fees are required or if any fees are overpaid, please appropriately charge or deposit those fees to Conley, Rose & Tayon, P.C. Deposit Account Number 50-1505/5659-03800/EBM.

Respectfully submitted,

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